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A N
E S S A Y
ON THE
CONSTRUCTION AND BUILDING
OF
CHIMNEYS.

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A N
E S S A Y
O N T H E
CONSTRUCTION AND BUILDING
O F
C H I M N E Y S.

INCLUDING
An ENQUIRY into the common Causes of
their SMOKING,

A N D
The most effectual REMEDIES for removing
so intolerable a NUISANCE:

W I T H
A TABLE to proportion CHIMNEYS to the Size of the
Room,

Illustrated with proper FIGURES.

BY ROBERT CLAVERING, BUILDER.

THE THIRD EDITION, CORRECTED.

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INTRODUCTION.

THE following tract is directed to the investigation of an essential article in building, not hitherto considered so minutely as the importance of the subject deserves.

It is not to be mentioned without astonishment, that so many able and ingenious artists, who have travelled over Europe to acquire knowledge in architecture, and who have designed and erected buildings in this country, far superior for strength, lightness, and elegance, to any that are to be found abroad, should, nevertheless, have neglected to ascertain the principles of a convenience, the due execution of which is necessary to render every habitation comfortable, from the cottage to the palace ! Nor is it less surprising, that the laudable Society instituted for the Encouragement of Arts,

Manufactures, and Commerce, among all their liberal premiums for discoveries of public utility, have never offered encouragement for the best regular theory of the construction and building of chimneys !

My thoughts first turned to this subject in the year 1764, whereon I consulted several able bricklayers, but failed in receiving any satisfactory information : they all differed in opinion, particularly in respect to gathering the breast and wings of chimneys, and in the size and direction of the funnels, without assigning any substantial reason why they should be constructed one way rather than another ; saying only, such was the best way, and they always did so themselves.

As I was then engaged in building several houses, I began to try experiments ; and if they were not attended at first with positive success, they led to important discoveries, which immediately enabled me to find where some defects lay, and to make many useful remarks.

About the year 1767, I met with Dr. Mead's

Mead's account of Sutton's ingenious pipes for extracting foul air out of ships, to which I was indebted for my first knowledge of the properties of air and vapour, and their powerful rarefaction by fire. I afterwards met with Sutton's Treatise on Smoky Chimneys; but here I found him erroneous in many respects, particularly in his directions for constructing chimneys, which I knew by experience to be wrong.—I then read several of the best physical and mechanical authors on air, fire, &c. and having opportunity at that time, I made several trials respecting chimneys, with better success than before.

In my further researches, I met with the late Edinburgh *Encyclopædia Britannica*, wherein, under the article of Smoke, I received great information. In short, I have read every author I could find on the subject, or any ways relating thereto; and in the whole course of my practice in building, I have never neglected any opportunity of making remarks and observations from experience on the many buildings I have surveyed and inspected.

I am very sensible I run no small risque of censure from some of the lower order of surveyors, and more particularly from the whole tribe of advertising chimney doctors. We know by general experience, that every innovation in common usage, before the utility is demonstrated, is laughed at by interested snarlers, and the daring authors of them treated as fools and madmen. This is the fate of all projectors, good and bad; and as they commonly die (as Pope says) without the reward of *solid pudding*, so they do not always live even to reap the satisfaction of hearing the *empty praise* afterwards bestowed upon their labours. However, from GENTLEMEN of superior knowledge, and from ingenious and experienced artists, more liberal treatment and more mature decision may be expected.

I well know the great difficulty there will be in procuring chimneys to be executed on the principles here recommended; for, conceited surveyors and master bricklayers, who think themselves insulted by receiving direction, and ignorant workmen, who are confounded,

founded, and of course become refractory, if put out of their old methods, will unite in a confederacy to thwart the intentions of their employers, and rejoice with malignant pleasure if they succeed in effecting his disappointment. Nevertheless, I advise gentlemen by no means to be argued, or rather teased out of a plan that carries conviction with it, by obstinate ignorance. There are many experienced and ingenious bricklayers to be found, willing and capable to execute any judicious orders, in the most perfect and substantial manner. I have consulted several able workmen on the subject, particularly on gathering the wings and making circular funnels to the chimneys, who all agree they may be easily executed by more methods than one.

I leave the utility of this performance to the impartial judgment of the public, assuring them, that the pleasure I shall receive from their approbation, will be measured by the benefit they may receive from my labours.

ROBERT CLAVERING.

July 10th, 1779.

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A

DISSERTATION ON THE CONSTRUCTION OF CHIMNEYS.

NO situation in life can be more uncomfortable and unhealthy than residing in a smoky house: it is not only offensive to our sensations, but destroys all domestic enjoyment. Rooms ever so beautifully decorated, are, in this case, always dirty, and the most superb furniture is spoiled.

It is the most essential, and ought to be the principal object with the architect and builder, to construct and execute chimneys on such a plan as to convey up all the smoke.

But it is evident that the most eminent architects have never properly ascertained the true principles of giving a proper draught to a chimney, or they would not, at this time, disfigure the chimney tops on the most splendid and magnificent edifices, with pots. They are disgraceful in appearance, and indicate a deficiency of skill not to be pardoned; as chimney shafts may be finished, in the truest taste, without such clumsy expedients. To a well constructed funnel they are very injurious, and are, besides, attended with a long train of disagreeable, and even dangerous circumstances; being only useful in peculiar situations.

The various experiments that have been tried by pretenders, who have undertaken the cure of smoky chimneys, are beyond conception! But, unfortunately, these contrivances have been the random attempts of ignorant men, wholly unacquainted with the physical cause of the ascent of vapour; namely, the powerful rarefaction of air by heat.

There is not any branch, perhaps, of natural philosophy that has more engaged the attention

attention of the learned, or been more successfully cultivated of late, than the nature of air; and this in almost every circumstance whatsoever, excepting the application of it to the doctrine of chimneys.

The present design, therefore, is to supply this defect, by giving plain and easy directions for constructing and executing chimneys; which, if attentively observed, will put an end to the nuisances so justly complained of at present.—For the more clearly comprehending the several principles relating to this subject, it will be necessary to explain the general nature and operation of fire and air, the agents in conveying smoke through those channels which constitute the subject of our dissertation.

Fire is an agent, of which the power is great, its effects extensive, and the manner of its acting wonderful. Philosophers are much divided in their opinions concerning the origin and nature of it; but the discussion of these would be tedious, and foreign to our purpose, which is only to consider its effects.

There seems to be no other difference between fire and flame, than, that fire consists in a glowing degree of velocity in the parts of a body, while yet subsisting in the mass; and that flame is the same degree of velocity extended to the detached particles, whilst flying off in exhalation. In brief, flame is red hot smoke.

The smoke of coals is more gross, unctuous, and weighty, than that of wood, turf, or any other common fuel; it therefore adheres to the sides of chimneys in its passage, in the form of foot, in a larger proportion.

Air possesses some qualities peculiar to itself, but is subject, in general, to the same physical laws with other fluids. Those properties which we are now more immediately concerned in, are, first, its weight or gravity; secondly, its condensation; thirdly, its fluidity; fourthly, its rarefaction; and fifthly, its elasticity.

First, that the air gravitates, or acts upon inferior bodies, is evident, from numberless experiments of the air-pump and barometer.

The

The weight of air is continually changing, in proportion to the different degrees of heat or cold, &c. by which it is affected ; and this weight is greater, the nearer it is to the earth's surface, because the lower regions of the air sustain the pressure of the whole superior body of the atmosphere.—(Vide Sir Isaac Newton's Optics.)

Secondly, Mr. Boyle, by various experiments, proves that air may be condensed so as to occupy but $\frac{1}{60}$ part of the space it possessed before. It is found that the power of its elasticity is according to its density, and its density is found, by experiments, to be equal to its compression.

Thirdly, that air is a fluid is evident, by its yielding to every force.

Fourthly, it is proved, by computation, that the air at seven miles altitude from the earth, is four times rarer, thinner, and, of course, lighter, than at the surface ; and at fourteen miles altitude, sixteen times rarer ; at twenty-one miles, sixty-four times, and so on, in geometrical proportion of rarity, compared

pared with the arithmetical proportion of its altitude. (Vide Sir Isaac Newton's Optics, page 342.)

That air is rarefied by the fire is evident, by the experiment of an empty bladder, tied close at its neck, and laid before a fire ; which will so rarefy the little inclosed air, as to distend the bladder to its utmost stretch, and at last burst it, with a report equal to that of a pistol.

Fifthly, the elasticity of a body is its property of returning forcibly and spontaneously to its original state immediately after it hath been altered, by a force applied to it ; and is called the spring, or re-action of the body ; and this property is peculiarly observable in air.

As the air is compressible by art, so is it contracted by cold, and expanded by heat : hence its density is always in proportion to its natural temperature as to cold or heat,

To bring this doctrine home to our subject, it will be necessary to observe the following effects

effects of fire on the air in rooms, &c. where it is placed.

If in a middle-sized room, with two fire-places, a large brisk fire is made in one (the doors and windows being shut) it will soon bring the air down the other chimney with such force as to put out a candle. If fires are kindled in both, and there are any closets or cavities in the room, it will draw the air from them with the same velocity ; or if a door be shut (but not fastened), it will open a little by the draught of air inward. When the fires are both put out, and the room cooled, it will, on the contrary, shut close of itself. Again, if the funnel of one of the chimneys is stopped up, the smoke will direct its course to the other fire-place immediately.

These fires are only fed and preserved by a constant draught of air, which being rarefied by the fire, and rushing up the chimney, conveys the smoke along with it into the higher regions of the atmosphere* : but if the funnels are

* Dr. Franklin, to prove that smoke is really heavier than air, proposes the following simple yet ingenious experiment. Having lit a pipe of tobacco, plunge the stem to the bottom of

are closely stopped up, together with the doors and windows belonging to the room, the fires will immediately die away, and at last go out.

Sir John Pringle, the late president of the Royal Society, in his discourse on air, delivered at the anniversary meeting, November 30, 1773, says, page 22, "It is well known that flame cannot long subsist without a renewal of common air. The quantity of that fluid which even a small flame requires is surprising; an ordinary candle consumes, as it is called, about a gallon of air in a minute."

If there is a large fire in a room, and the door opened a little, so as to admit it to draw, hold a candle at the top of the door, and the air will drive the flame outwards; hold the candle in the middle, there will be no draught

a decanter half filled with cold water; then putting a rag over the bowl, blow through it, and make the smoke descend in the stem of the pipe, from the end of which it will rise in bubbles through the water; and being thus cooled will not afterwards rise to go out through the neck of the decanter, but remain spreading itself, and resting on the surface of the water. This shews that smoke is really heavier than air; and that it is carried upwards only when attached to, or acted upon, by air that is heated, and thereby rarefied and rendered specifically lighter than the air in its neighbourhood.

at all ; but if it is held at the bottom, the air will drive the flame in toward the fire. This proves the rarefaction of the air by heat ; and that the property of rarefied air is to ascend, from the diminution of its gravity. The following inference may be drawn from this experiment ; that fire can neither be collected, preserved, increased, or regulated without air ; consequently, our endeavours must be directed to regulate the course of it, with reference to the chimney.

From these principles, it is obvious, that a fire once lighted in a room is preserved by a constant draught of air from the room ; and the air at the opening of the chimney below being effectually heated and rarefied, will directly ascend, and carry off the smoke through the funnel provided for it, to the top of the building ; the action of the fire at the lower extremity of the funnel being stronger than the cold external air at the aperture above. The air will successively press in at all openings in the room below, which forcing the flame and smoke in the fire-place to the back of the chimney, will become equally elastic and rarefied with them, and ascend up the

the chimney with great rapidity. Thus a draught of air is maintained by the fire, if it meets with no impediment by defects in the funnel of the chimney.

From what has been stated, the following corollaries naturally arise :

First, that before a fire is lighted, the chimney contains a body of cold, condensed, and stagnated air, which, according to the laws of nature, is in a state of rest: but the fire being made, becomes the seat, or centre of motion, by rarefying the air in the mouth of the chimney: this acts against the stagnated air in the funnel, producing a current, which continues as long as the fire is kept up, more or less, according to the degree of heat.

Secondly, it is also evident, that the more the air is heated and rarefied, with the greater celerity it will ascend. Therefore the nearer the air is made to pass the fire, the more heated and rarefied it will be.

Thirdly, that the rarefied air will ascend through the chimney nearly of an equal degree of heat, to the top of the funnel, if not

not prevented by any unnatural obstruction in the funnel, is clear, from daily observations.—Hence it follows, that a chimney should be constructed and proportioned, in all its parts, according to the size of the room, and erected with the greatest care and circumspection.—These observations, are founded on principles too obvious and certain to be denied, without, at the same time, denying that the laws of nature are uniform, or supposing the effect greater than the cause, which is impossible.

Having thus far explained the nature and operations of fire and air, relating to this branch of our subject, we will proceed to the several causes of smoky apartments, and point out the errors, both internally and externally, as to the construction and position of chimneys.

O B S E R V A T I O N S
O N
S M O K Y C H I M N E Y S.

IN almost every thing relating to building, we may refer to the rules and practice of the ancients for models and examples of improvement; but, in respect to chimneys, we have no such resource.

All that we find in Vitruvius, and other ancient writers, on chimneys, is short and trivial; and the rules for constructing them, full of obscurity. Indeed, as they lived in warmer climates than ours, they had the less occasion for them; and the use of stoves rendered chimneys an object of little attention. Some occasional directions for the construction of chimneys have been published, by several modern authors, in treatises on buildings; but most of them are very erroneous, and none of them satisfactory, either to gentlemen or workmen.

Our necessity for chimneys in this climate is absolute; nothing, therefore, more essentially claims our attention than their proper construction and disposition. The judicious architect and builder ought to adjust the size of the chimney in due proportion to that of the room; having a respect to the distribution and situation of doors and windows, and a particular regard to external objects.

The several causes of defects in chimneys are numerous, but may be reduced to the three following principal heads:

First, a bad and faulty construction and execution of one or several parts of the chimney itself.

Secondly, some fault in the other parts of the house, respecting their position or proportion to the chimney; as for example, the position and situation of doors and windows, closeness and size of rooms, &c.

Thirdly, to external obstruction, as higher buildings; greater elevation of ground, as hills; and the nature of the region also from

what quarter the furious winds mostly blow, &c.

First, as to a bad and faulty construction of one or more parts of a chimney.

A CHIMNEY is so agreeable an object that it attracts more than an ordinary share of our attention; and, if it is decorated with judgment and taste, is an elegant ornament. Its principal parts are,

The HEARTH, floor, bottom, or pavement of a fire-place, on which the grate, stove, or dogs, are placed, for the reception of our fuel.

The CHIMNEY-JAMBS, or sides of a chimney, which are generally at right angles from the back, as at *g, f, fig. 6*, but are sometimes circular, or elliptical, as *w, y, z, fig. 8*, or in an obtuse angle, sloping outward, as *o, p, q, r, fig. 7*, from the back.

The MANTLE-PIECE, which is the lower part of the breast or front of a chimney, as *a, a; a, fig. 4*. Formerly it was a piece of timber

ber that lay across the jambs (and was then called the mantle-tree), and supported the breast-work ; but by a late act of parliament chimney-breasts are not to be supported by a wooden mantle-tree, or turning-piece, but by an iron bar, or by a brick or stone arch.

The OPENING, Fire-place, or Mouth of the chimney, is the aperture, or vacancy, in which stands the stove or grate, as *a, b, c, d*, at B, in *fig. 1*, whose height is the space between the hearth and the mantle-piece ; the breadth, the distance between the jambs ; the depth, from the front of the jambs to the back of the chimney, as at *g, f, fig. 6.*

The MOUTH of the FUNNEL, or Tube, is the contracted part, or gathering of the wings (or upper part of the jambs) and breast of the chimney, to the proper size of the funnel ; or is the space between the lower edge of the mantle-piece and funnel, as *d, l, m, e*, at A, in *fig. 1.*

The FUNNEL, &c, is a tube, conductor, or conveyance, through which the air and smoke ascend and disperse in the upper re-

gions of the atmosphere, as at *b, b, b, b, b,* *fig. 1.*

FLUES are small winding tubes, or funnels, carried up into the main funnel from coppers, furnaces, ovens, or stoves, in large kitchen chimneys, as *i*, in *A, fig. 1*, or where there are one or two divisions in the gathering of a large chimney.

SHAFTS of CHIMNEYS are the extreme parts of the stone or brick work, round the funnels above the roof, which admit of being finished in an ornamental taste, according to the orders of architecture, as *G H, fig. 1.*

The errors in the construction and execution of these parts of the chimney which occasion smoke, are of the following nature:

The opening, or fire-place, being too large in its dimensions for the apartment. For if the chimney-piece is too high, the distance between the fire and the mantle-piece permits the cold air to pass above the fire, without being properly rarefied, as *b* in *B, fig. 1.* It is also very common for chimneys to be

much wider than the grate, as at the stove represented in B, *fig. 1*, which equally admits great quantities of cold air to pass at each side. Again, if the fire-place is too deep, the grate standing far back, the air is not heated as it enters ; and if the grate is brought forward, and a vacancy left at the back (as represented by the stove at B, in the same figure), the evil will not be remedied, unless the back of the stove is built up with brick-work, as is represented at *d*, in C, *fig. 4* ; for the air will pass under the stove, and ascend behind it very little rarefied.

In all cases of this sort, where there is a quantity of cold air permitted to enter the chimney, without being properly heated and rarefied by the fire, the smoke is stifled, and checked at the first setting off, and, stagnating, will return into the room.

Therefore the nearer the air is made to pass the fire on all sides, the more rarefied it will be ; and the less vacancy there is in the chimney-place, it will ascend up the funnel with the greater rapidity. In such cases, it is found that a proper contrac-

tion of the chimney-place cures the smoke, if there is no other obstruction or cause interfering.

Secondly, smoke is also occasioned by not contracting or gathering the wings and breast of the chimney in a proper manner.

When the aperture of the fire-place, above the under edge of the mantle-piece, is carried up tapering slowly towards the next story, as *a, b*, at A, *fig. 3*, or gathering narrower all the way to the top of the chimney, as *c, d*, at B, in *fig. 3*, the consequence is, that a large quantity of cold air hangs lingering about. The chimney being loaded with fuliginous vapours not duly rarefied, they hover round in eddies, and almost equiponderate with the rest of the atmosphere ; whereby the ascent of the smoke is so stagnated, that the least gust of wind drives it back into the room.

The only remedy for this evil is contraction in that part ; the cheapest method to perform which is, by fixing a sheet of milled iron on each side, within the mantle, as low as possible, slanting up towards the middle of the chimney.

chimney ; and this may be fixed by an ingenious workman with such neatness as not to be perceived, and so as to regulate the draught of the chimney at pleasure ; as described in the explanation of *fig. 3.*

Some workmen, of late years, have run into an opposite extreme, by contracting the breast and wings of the chimney in such a manner as to form the mouth of the funnel close to the mantle-piece, as represented in *fig. 2*, where the dotted lines at *a* below, shew the under edge of the mantle. But this is a greater evil than the last ; for when the fire is first kindled, greater quantities of vapour fly off, and the funnel being filled with cold, condensed air, the vapour being expanded by the fire, and endeavouring to ascend, is checked and stifled by the sudden contraction at the mouth of the funnel, and the ascent prevented by the weight of the column of condensed air above, is therefore forced into the room before it can overcome the resistance.

The cure for this is disagreeable. To cut away the stone or brick-work, to give room for the expansion of the air, as at the dotted lines *b, b*, in *fig. 2*, may be dangerous to the

bond

bond of the chimney, particularly if funnels interfere; and to lower the mantle may be inconvenient. If neither can be done with propriety, which must be referred to the judgment of the workmen, the only ready remedy is to have a blower, made of milled iron, or a plate of brass, the whole width of the chimney, to come as low as the upper bar of the grate or stove, and to hang a hook to the chimney-piece, as occasion requires. This will not only carry off the smoke, but make the fire burn briskly.

Thirdly, smoke is occasioned by wrong construction, and bad execution of the funnels or tubes of chimneys.

The faults in funnels, both in construction and execution, are many. It is no less astonishing than true, that the principal cause of the smoking of chimneys, in London particularly, is owing to the careless, slovenly, and bungling execution of the funnels. I have seen them, in capital new houses, so choked up in more places than one, that they could not be cleared till the brick-work of the chimney had been cut away, and such large

quan-

quantities of brick-bats and rubbish taken out, that any one might justly suppose it done designedly; whereby the paretting, or plastering on the inside of the funnel, if any there were (for it is not uncommon with some gentlemen bricklayers to forget, or neglect it at times), is broke and destroyed, whence the inside thereof must remain rough, ragged, and uneven, which greatly impedes the free ascent of the air and smoke, and can never be mended.

It is often the case, that funnels are carried up narrower at one place than another, and with bulges, which greatly stagnate the air and smoke in their passage, making lodgements for large bodies of foot. This is often the cause of chimneys taking fire, renders the sweeping of them very difficult, and is the occasion of large lumps of foot falling into the fire, as the funnel *a, b, c, d, e, f, g, h*, at *A*, in *fig. 3.*

Another fault, often committed, through sloth, ignorance, or carelessness (it would be uncharitable to impute it to design), is, where funnels wind, bend, and turn, in their course.

If these deviations from a vertical direction are made sudden and acute, they always obstruct the free passage of the air and smoke, even if the bricks are cut true to the splay, which is seldom the case. I have often seen bricks laid whole, one back upon another (in turns or bends) like steps of stairs; and on the opposite side projecting square over one another, as is represented by *b, c, d, e*, at A, *fig. 3*, which makes the air and vapour linger in the funnel, and never go off freely, and always occasion smoke, and a long train of other bad consequences.

These defects are unpardonable, being occasioned by nothing but mere negligence in the execution of the work. They are incurable, and will baffle all the troop of quack chimney doctors in their endeavours to make them perfectly clear of smoke. They may put their gloomy looking blowing stoves below, and their ugly, dangerous machines at the top of the chimneys; but all their patch-work will have no effect in these cases. It is only picking the proprietors pockets to attempt a cure.

These are some of the shameful, blundering, and incurable faults of a great number of our modern chimneys, in the most splendid and magnificent edifices.

If a funnel be made too narrow to receive the smoke with freedom, it will then naturally be forced into the room to find some other passage ; this defect is very common, and the remedy troublesome and difficult.— The most effectual cure, if the situation will admit, is to build a small additional flue, and open a hole into it from the back of the chimney, near the level of the mantle-piece, slanting upwards in an easy direction ; this supplemental flue must be carried to the top of the building to receive the surplus of the smoke, and will prove a certain cure.

But if the situation will not allow of this expedient, the fire-place may be contracted, both in breadth and height, if it can, with convenience, be admitted ; a smaller grate or stove used, and the chimney heightened at the top : which will oblige the air to pass close over the fire, and carry up the smoke with greater

greater rapidity ; for the quicker the current, the less room it requires.

If that only cures in part, and the chimney smokes still at times, a blower, or front plate of brass, or milled iron, to put on and take off at pleasure, as before described, will be of use.

But if none of the above prescriptions will answer, the last remedy is, to fix a blowing stove in the fire-place, which makes the air go through the fire, as in a furnace, and accelerates the ascent both of the air and smoke with great velocity.— Yet we can by no means recommend blowing stoves of any kind, but as a dernier resort ; they consume a prodigious quantity of fuel, and never warm the room properly, by being so confined and concealed ; for while a person is scorched with the fire on one side, he is chilled and cold on the other. An open fire is a cheerful companion, and an agreeable object : but these stoves, which conceal the fire, are not only disagreeable, but dangerous, if great care is not taken of them. Should this last method fail, the chimney may be deemed incurable.

If a funnel is made very wide at bottom, and contracted very narrow at the top of the chimney, or nearly so, as is often the construction with garret chimneys, a funnel built on this plan will certainly smoke; from the same cause as is assigned in the article of gathering the wings and breast of a chimney in a gradual tapering direction from the mantle-piece to the top of the funnel. See pages 24 and 25, and *c, d*, in A, *fig. 3.*

To cure this defect, the same method may be used below at the mantle as is there prescribed; by fixing a sheet of milled iron on each side, and raising and contracting the top of the funnel, if it can be done without injuring the adjoining funnels.

Having explained several of the principal causes of smoke, in the construction of chimneys, with the remedy where they are curable; we shall only add two or three more observations, which, though they may be esteemed trifling, may yet be found useful.

When part of the top of a chimney is broken down, it causes the chimney to smoke, when the

the wind blows in that direction. Therefore, mending the top, and keeping the upper edge level and even, cures it.

It sometimes happens that an apartment is filled with smoke when a fire is kindled in an adjoining chimney, and no fire in the in-commodeed room ; although it does not smoke when it has a fire burning in its own grate.

This may arise from two causes ; first, by the wind driving the smoke down the funnel of the adjoining room, along with the cold air that may be forced down by some accidental gust, or diversion of wind in the house ; to prevent which, raise a circular partition between the funnels at top, about three inches, which will prevent it ; or by coping the chimney with stone, as afterwards directed.

Sometimes it happens from holes being in the partition that divides the two funnels ; for as smoke is of itself a dense body, buoyed up by the rarefied air only, so, when it enters the cold tube, it naturally descends, and comes down into the room.

Some persons will undertake to cure this, as well as perform other impossibilities, and run gentlemen to an immense expence to no purpose. There is no perfect cure for it but pulling down the chimney to the part where the holes are, and rebuilding it in a sound manner.— The only relief, short of pulling it down, is to make use of a smoke-board, fitted exactly into the aperture of the chimney, even with the under edge of the mantle; which will, in part, stop the smoke from entering the room. Therefore great care should be taken that the partitions between funnels be built sound and solid, and well plastered or par-gated on both sides, to prevent this evil.

If a stack of chimneys in a gable end, or flank wall, is exposed to the wind, great care ought to be taken that there be no little holes or cavities, through the wall, into any of the funnels ; if there are, when the wind blows in that part, the chimney is sure to smoke. The wall should, therefore, be pointed down with great care, and good mortar used.

It is known that large sums of money have been fruitlessly wasted in experiments on

chimneys so situated, before the real cause was discovered ; but when the wall was pointed down with care and good mortar, and the machinery taken off from the top of the funnels, they did not smoke in the least. We have known more instances of this than one.

PROPORTIONS of the several Parts of a
CHIMNEY, according to the Size of the
APARTMENT.

FROM the several principles already advanced, it is demonstrably clear, that the dimensions of every chimney, and parts thereto belonging, should be proportioned to the size of the room ; for every room contains a portion of air equal to its capacity, which requires a proportionable degree of fire to render it comfortably warm.

For obtaining a clearer idea of the application of these principles to the different parts of chimneys, several mathematical and philosophical inferences may be deduced, and comparative calculations formed. From experiments made with the air-pump, barometer, and hydrostatical instruments, by Sir Isaac Newton, Mr. Boyle, and other eminent philosophers, we have diligently acquired sufficient data to form the following table with the greatest accuracy and precision : and, as the rules for suiting the dimensions of the dif-

ferent parts of a chimney to the size of the apartment, are so plain and easy, and never before attempted, we hope they will be acceptable to the public.

The following table of dimensions is adapted to all rooms except kitchens, whose chimneys need not be confined to the nice proportions required in dining-rooms, parlours, bed-chambers, dressing-rooms, closets, halls, &c. Kitchen chimneys are necessarily of a larger size, for the convenience of the various operations of cookery; and if the range is made suitable to the opening of the chimney, and properly set, the gathering of the breast and wings, and the funnel be properly executed, as hereafter explained, there will be no danger of smoke. The fire being sufficiently large, rarefies the air accordingly; and the steams flying out of pots and kettles, assist the ascent of the air and smoke, and carry them off with great velocity.

A TABLE of the Proportion of the several Parts of a CHIMNEY, according to the Magnitude of the Apartment. Calculated on Geometrical Principles, and confirmed by Experience.

First Column.	Second Ditto.	Third Column.		Fourth Column.		Fifth Column.		Sixth Column.	Seventh Column.	Eighth Column.
If the square of the room be 6 feet	The two thirds will be	Breadth of the Chimney.	Height of the Chimney.	Breadth of the Chimney.	Height of the Chimney.	Breadth of the Chimney.	Height of the Chimney.	Depth of the Chimney.	Square of the Funnel.	Diameter if circu- a.
4 0	4 0	I 3	3 2	I 4	3 0	I 6	2 9	I 3	0 10	0 11
7 0	4 8	I 5	3 3 1/2	I 6	3 1 1/2	I 8	2 10			
8 0	5 4	I 8	3 2 1/2	I 10	2 11	I 11 1/4	2 9			
9 0	6 0	I 10	3 3 1/2	2 0	3 0	2 1 1/2	2 10			
10 0	6 8	2 0	3 4	2 2	3 1	2 3 1/2	2 11			
11 0	7 4	2 2	3 5	2 4	3 2	2 5 1/2	3 0	0 11	I 0	
12 0	8 0	2 4	3 5 1/2	2 6	3 2 3/4	2 7 1/4	3 1 1/2	I 6		
13 0	8 8	2 6	3 6	2 7 3/4	3 1 1/4	2 9 1/4	3 1 1/2			
14 0	9 4	2 8	3 6 1/2	2 9 3/4	3 4 1/2	2 11 1/2	3 2		I 0	
15 0	10 0	2 10	3 6 3/4	2 11 1/4	3 4 1/2	3 1 1/2	3 2 1/2			
16 0	10 8	3 0	3 7	3 1 1/2	3 5 1/2	3 3 1/2	3 3 1/2			
17 0	11 4	3 1 3/4	3 7 1/4	3 3 1/2	3 5 1/2	3 5 1/2	3 3 1/2		I 1	I 2
18 0	12 0	3 3 1/2	3 7 3/4	3 5 1/4	3 6	3 7 1/4	3 4 1/2			
19 0	12 8	3 5	3 8 1/2	3 7	3 6 1/2	3 9	3 4 1/2	I 10		
20 0	13 4	3 6 3/4	3 9	3 8 3/4	3 7	3 11	3 5 1/2			
21 0	14 0	3 8 3/4	3 9 1/2	3 10 1/2	3 7 1/2	4 0 3/4	3 5 1/2			
22 0	14 8	3 10	3 10	4 0	3 8	4 2 1/2	3 6	I 2	I 1	2 1/2
23 0	15 4	3 11 3/4	3 10 1/2	4 1 3/4	3 8 1/2	4 4	3 6 1/2			
24 0	16 0	4 1 1/4	3 11	4 3 1/4	3 9 1/2	4 5 1/2	3 7 1/2			
25 0	16 8	4 2 3/4	3 11 1/2	4 5	3 9 1/2	4 7 1/4	3 8			
26 0	17 4	4 4	4 0	4 6 1/2	3 10	4 8 3/4	3 8 1/2		I 3	I 3 1/2
27 0	18 0	4 5 1/2	4 0 1/2	4 8	3 10 1/2	4 10 1/4	3 8 1/2			
28 0	18 8	4 7	4 1	4 9 1/4	3 11	4 11 1/4	3 9 1/2			
29 0	19 4	4 8 1/4	4 1 1/2	4 10 3/4	3 11 1/2	5 2 3/4	3 10	2 0		
30 0	20 0	4 9 3/4	4 2	5 0	4 0	5 4	3 10 1/2			
31 0	20 8	4 11	4 2 1/2	5 1 1/2	4 0 1/2	5 5 1/4	3 11 1/2			
32 0	21 4	5 0 1/4	4 3	5 2 3/4	4 1 1/2	5 5 1/4	3 11 1/2		I 4	I 4
33 0	22 0	5 1 1/2	4 3 1/2	5 4	4 2	5 6 3/4	3 11 1/2			
34 0	22 8	5 2 3/4	4 4	5 5 1/4	4 2	5 8	4 0 1/2			
35 0	23 4	5 4	4 4 1/2	5 6 1/2	4 2 1/2	5 9 1/4	4 4			
36 0	24 0	5 5 1/4	4 5	5 7 3/4	4 3	5 10 1/2	4 4			

EXPLANATION of the TABLE.

THE first column is the square of rooms from six feet to thirty-six feet square; to find which, add the length and breadth of the room together, and take half that sum for the mean proportion.

The second column is $\frac{2}{3}$ of the first column, and gives the proper superficial contents of the opening or mouth of the chimney.

The third, fourth, and fifth double columns are three differently calculated proportions of the breadth and heights of chimney-pieces, which multiplied together, the contents will be the same, or near to the second column, or two-thirds of the square of the room. All these dimensions are calculated to be the size of the chimney-piece, when completely finished; therefore covenings, slips, and nosings, &c. (if any) are to be allowed for in the breadth of the chimney, in carrying up the work.

The sixth column is the depth of the chimney from the front of the jambs to the back.

It follows nearly in a direct ratio of proportion in matter, that the $\frac{1}{4}$ of the square of the opening gives the depth of the chimney ; but as there is no rule without exception, and in this particular experience has proved that no chimney should be shallower than 1 ft. 3 in. or deeper than 2 feet, I have therefore calculated and divided this column into four parts or proportions, which will be more convenient to workmen, and answer the purpose better than to have a proportion to every size.

The seventh column is the dimension of the square of the funnel : the rule for finding this is to take the $\frac{1}{6}$ for the square of the funnel ; but it falls under the same predicament as the last ; for experience has proved, in many instances, that no funnel, if properly executed, ought to be less than 10 inches, or more than 16 inches, being a tube sufficient to carry off any body of smoke arising from any common fire ; and to be made according to the size of the room, as marked.

The eighth column gives the diameter of a circular funnel, which will hereafter be more fully

fully explained. N. B. Observe that these are the dimensions of the flue when finished ; so the thickness of the pargeting on both sides must be allowed for in carrying up the work.

These calculations are made for rooms from 10 to 12 feet high, clear from the floor to the ceiling ; if more, for every foot the ceiling is higher, add one inch to the breadth of the opening to the chimney, one half inch to the height, one quarter of an inch to the depth, and about one eighth, or a little more, to the square, or diameter of the funnel. And if the ceilings are lower than ten feet, reduce the parts by the same proportion.

With regard to the height of the chimney-pieces, I would recommend none in dining-rooms, parlours, &c. wider than five feet, or higher than four feet, even in the largest apartments. For which reason I would have carried the table no farther than a room of thirty feet square (and that, indeed, is a room too large for one fire-place) ; but as particular reasons may sometimes happen for their being

larger, the table is carried to thirty-six feet square.

A large apartment with only one fire-place is neither comfortable nor agreeable: it can never be regularly warmed in all parts, nor decorated with desirable symmetry and elegance. Whereas two small fire-places will distribute an uniform degree of warmth through the whole.

To find the dimensions of chimney-pieces where two fire-places are required in a room, according to its size: Suppose a room to be fifty feet long, and thirty feet wide; added together is eighty, the fourth part of which is twenty feet, which is half the square of the room. Now look for 20 in the first column, and opposite, in the third, fourth, and fifth columns, you find the proportions of the openings required for two chimneys of a room of that size; and by the same method you find the proportions adapted for any other room.

These dimensions may be somewhat enlarged,

larged, if thought necessary, but must be done with prudence.

The third, fourth, and fifth columns are three differently calculated proportions of the heights and breadth of chimney-pieces for rooms of any size, whereby gentlemen or surveyors may choose which they think best adapted to the apartment, in respect to the height of the mantle. If a small house for working people, the higher the mantle the more convenient for them; but proportion may be more strictly adhered to in genteel houses.

On the CONSTRUCTION and EXECUTION of CHIMNEYS.

First, Of the Fire-Place, or Opening.

HAVING finished the table of proportions for the several parts of a chimney, we shall now enter on the most important subject, of planning, erecting and executing them in a proper manner and form; which, if truly observed, and followed by the workmen, gentlemen may be assured of being freed from the worst of all plagues, that of smoke in their houses.

The first particular is that of the fire-place, or opening, as the foundation work. We have already mentioned the evil consequence attending the fire-place being too large for the grate, either as to height, breadth, or depth, viz. preventing the air entering it from the chamber from being well rarefied; which will also be the case where the jambs and back are carried up square, as *d, g, f, fig. 6*, and a small grate or stove fixed in it, as *h*, in *B, fig. 1.*

The

The most perfect and complete way to carry up that part of the chimney, and what we would recommend to every gentleman, is, to have the jambs and back of the chimney at the fire-place to form a segment of a circle, or an ellipsis, as in the plan at *w, y, z*, in *fig. 8*, whereby the corners being filled up, prevent any cold air lodging, or hovering about there, to obstruct the ascent of the smoke.

We could wish to reply to such objections as may be made to any useful improvement recommended ; and we well know that several workmen will object to this simple improvement, by representing the extra expence of carrying up the brick-work, and the extra expence of circular covings, particularly if they are marble. Circular marble covings we know to be expensive ; but Portland stone is not so dear : or if the insides of chimneys are set with Dutch, or gallery tiles, the expence is no object ; and even marble, with Bath stoves, will not come very high. But this objection will be obviated by having plain or flat jambs to slope inward, with

with an obtuse angle from the wall, or back of the chimney, as *o, p, q, r*, in *fig. 7*, (which will be no more expence of any materials than the square chimney-place, *fig. 6*) and will in part answer the purpose intended, though not so completely as if circular or elliptical.

Secondly, Of contracting and gathering the Breast and Wings of a CHIMNEY from the under Edge of the Mantle to the Mouth of the Funnel.

THIS is a nice article, and ought to be executed in a masterly manner; on this depends the proper draught and free circulation of the air and vapour at the first out-set: we have already remarked the two extremes in common practice, and the evils attending them.

First, where the aperture above the mantle edge is carried up sloping slowly for a considerable height, as represented in the two funnels in *fig. 3*. And secondly, where the wings of the chimney are so suddenly contracted as to form the mouth of the funnel, almost at the

the under edge of the mantle-piece, as represented at *a*, in *fig. 2.* Both these extremes are to be avoided, as they are attended with the consequences before mentioned, and a chimney so constructed can never be clear of smoke.

The height of the gatherings, or arching, to chimney wings and breasts, ought to bear a proportion to the width of the opening, or fire-place, which may be fixed at, or nearly to the $\frac{1}{3}$ of the width: however, two or three inches under or over will not signify, as circumstances may happen, or situations require.—In the execution, the following rules are to be closely followed, as set forth in the fire-places in *A, B, C, D, and E, fig. 1*, viz. that the gathering of the wings on each side be sloping, or bevil, equally alike, so that the mouth of the funnel may be vertical over the middle of the fire, as represented by the dotted lines in the middle of the fire-places to the centre funnels in *fig. 1.* For the rarefied air, with the smoke or vapour, always rise from the burning fuel in a perpendicular direction, and a spiral form; and by

the

the funnel mouth being right perpendicular, they gather together in a regular body into the funnel. Secondly, observe that the brick or stone-work be cut true and smooth to the splay, or bevil of the arch, and not left ragged, as represented at *a, b*, in A, *fig. 3.*—The roughness will retard the ascent of the smoke, and be places of lodgment, and receptacles for the soot, whereby that part of the chimney will never be clean, even if swept with the greatest care.

The next thing to be considered in this article, is the form, or gathering of the breast of the chimney. In this it is to be observed, that the thinner the under edge of the breast of the chimney, or mantle, is, the greater is the advantage, as the grate may thus be brought forward towards the room. If the chimney is built with bricks, the arch may be turned upon a thick bar of iron, about two inches wide, and slant bevil upwards, as at *a, b*, in A, and *a, b*, in C, in the profile, *fig. 4.* regular to the funnel mouth, with the wings. If the chimney is built with stone-work, the arch may be made to taper from the under edge of the mantle, in a very small thickness.

The

The main point, in this particular, is the manner of gathering, arching, or contracting the wings and breast of the chimney together. If they are contracted in a square form, there will be unnecessary space in the corner for the cold air to harbour in, and obstruct the draught, as before observed.

The proper method is as at *a, b, c, d*, in *fig. 5*, which represents the setting off and beginning the arch, for the contraction, from the corners (as shewed by the dotted lines *e, f, g, h, fig. 5*) of the wings and breast in a circular form; beginning immediately at the under edge of the mantle-piece, as at *o, b*, in *C, fig. 1*, gathering regular to the mouth the circular funnel at *n, n*, in *ditto*.

At *n*, in *fig. 5*, is the representation of the mouth of a circular funnel, which *e, f, g, h*, is to be contracted to in a regular circular manner, at eighteen inches high from the under edge of the mantle-piece, at the dotted lines, *o, n*, in *C, fig. 1*. By this method of circular contraction, all the vacant room in the corners will be filled up, and the jambs and

and back of the chimney below (as before recommended) being carried up also circular, the chimney will so far be properly and perfectly constructed. And the gathering of the breast, wings, and back of the chimney being well and smoothly plastered, with good and strong mortar, made of hot lime and sea-coal ashes, will make it a masterly and complete performance.

*Thirdly, On the proper Method of executing
Funnels of Chimneys.*

THE funnel is the principal article belonging to a chimney, which to have perfect and complete, the funnel must be carried up with the best of materials, and executed in a masterly manner, with the greatest accuracy and circumspection, as regular, even, and smooth as possible. It should be of an equal degree of width from the bottom to the top, as a very small fault in a funnel will ruin the whole chimney ; and a fault in the funnel is of that disagreeable nature, that it cannot be remedied without pulling down the chimney entirely to the faulty part.

Having explained the proper method to construct and execute the fire-place, and for the contracting of the wings of the chimney to the mouth of the funnel, and shewn that the passage of the air and vapour into the funnel ought to be gradual and easy ; we go on to observe, from the same principle, that the mouth of the funnel may properly be a little wider at the beginning, and tapering slowly to its proper size, to make the ascent of the smoke free and clear from any sudden check, at the first outset, as is represented in all the funnels to the fire-places in *fig. 1*, where the funnels are about two inches wider for about two or three feet up, when the rest of the funnel to the top is of as equal a gauge as possible in every part. All necessary windings and bends should turn in an easy circular form, as is represented in the funnels, *fig. 1*, where sharp and acute windings are avoided : crooked directions in a funnel will not sensibly impede the free ascent of the smoke, if they are of a circular and easy sweep.

As the rarefied air and smoke by its nature ascends vertically, if the chimney will allow it, the higher the funnel can be carried

perpendicularly before the inclination or bending takes place, the better; for, by the smoke ascending at first in its natural direction, the current acquires strength to carry it through the inclined passage, as is represented by the dotted lines across, in the parlour, dining-room, and garret chimneys, in *fig. 1.* The parlour chimney funnel going 1 f. 8 in. perpendicular, the dining-room 2 f. and the garret 1 f. as marked in the margin; then the direction must be made to turn round the upper chimney, with as smooth and easy a course as possible; as the kitchen chimney funnel at A, and the two pair of stairs funnel at D, *fig. 1.*

It is a great advantage for all funnels to have a winding direction, as near to the top as possible; for, as strong, sudden, and accidental gusts of wind will sometimes enter, and beat into the top of a funnel, the first turning, or bend, will break the force of the wind, whereby the internal air and smoke will soon repel it, and proceed in its former course. But if the funnel is straight, and it meets with no interruption, it will stop the passage of the smoke for a while, and, of course, force what rises

rises from the fire immediately into the chamber. It is to be observed, that the further the wind gets down the funnel, the greater strength it will require to be repelled ; therefore, the nearer to the top the bend or winding is, the better, as *fig. 1.*

Also if there is little wind, with a very heavy shower of hail, snow, or rain, falling perpendicular in great drops, the first bend or turning will, in part, stop their progress ; if rain or snow, unless a very heavy shower indeed, and if hail stones, they will slide gently down the sides of the funnel, without disturbing the ascent of the air and smoke ; but if the funnel is perpendicular all the way down, the great drops of hail, snow, and rain will fall freely to the bottom, repelling the smoke along with it into the room ; and if the funnel is foul, will beat down great quantities of soot. These reasons recommend a bend in some part of the funnel as absolutely necessary ; and a more perfect, convenient, and easy method for such a direction can hardly be contrived, than as represented from the garret ceiling to the top of the chimney, *fig. 1.*

where the funnels gather in a natural declined direction, and rise afterwards in a perfect regular state, as at *b, b, b, b, b.*

Garret chimneys are more liable to smoke than any other in the house, owing to the shortness of the funnel: for when the rarefied air and smoke has made its way up a high funnel, it forms a strong column, and to repel it requires a proportionably great force, which in a garret chimney cannot be obtained; therefore what cannot be had from nature, must be aimed at by art. The fault in most garret chimneys is being carried up in a straight direction from bottom to top in a slovenly manner, and with funnels as large as any in the house; whereby the little internal rarefied air has the whole immediate pressure of the atmosphere to resist, which, in general, is too powerful for it. But a garret chimney carried up and executed in a proper manner, with due proportion in every part, according to the size of the room, and the funnel in an easy crooked direction (as *b, c, d, e*, at *E*, *fig. 1.*) will draw and be as clear from smoke as any other.

Be sure to work the funnel on the inside straight up at the top to the very edge, without the least variation, and to finish in the following manner: We recommend the upper shafts of chimneys, in genteel houses, to be of stone work, or at least the coping, as at *a, a*, in the shaft *G, H*, in *fig. 1*; and to prevent gusts of wind from blowing down, or the smoke of one funnel beating down another, let the external part of the wall round all the funnels be splayed, or champered, bevelled downwards on the out edge, as *a, a*, at the top of the shaft, *fig. 1*. For by this means the horizontal direction of the wind will be broke, and driven in a rising direction over the funnel; and the smoke ascending up will not be affected so much by it, even if it blows strong. The tops of the partition walls, between the funnels, are to be hollowed, or grooved, and are to be finished sharp, with the edge of the inside of the funnel, as *c, c, c, c*, at ditto; for there will always be a current of air passing through these grooves, which will divert the external air, and keep the top of the adjoining funnels clear from the smoke of the others, and also from the effects of the wind, blow from what part it will. This

plan properly executed with stone (for they cannot be done so with bricks) will prevent several bad consequences attending chimneys, and is the completest way of finishing their tops.

Chimney shafts, whether of stone or brick, ought to be executed with the very best materials, particularly the mortar; for being wholly exposed to the driving winds and rains, they are sooner affected, and decay before any other part of the building; and when the chimney is in a ruinous state, it is sure to smoke.

Mortar for the shafts of chimneys should be made with the sharpest and cleanest sand that can be got. The drift sand of rivers, where it can be had, is the best for that purpose; but we would recommend sea-coal ashes, free from wood ashes, dirt, or any other mixture, well incorporated, beat up, and worked, in the proportion of two parts of hot, or un-slacked lime, to one of sand or ashes.

The next thing to be considered is the form of the funnel. It is the general and universal custom to make the funnel in a square or

oblong form; which, on many accounts, is very improper. The corners of a square funnel, if ever so carefully pargeted and cleaned, contain a quantity of cold air; for the rarefied air, in its course up the funnel, never enters into them, as it always ascends in a circular form; therefore being square does not add to the width of the funnel, which, in strict truth, is only the inscribed circle. The air in the corners all the way up forming small eddies, are the occasion of the soot adhering and sticking there, which, by accumulating, forms into large knobs, and greatly retards the ascent of the smoke. These lumps occasionally detached, by frequently falling into the room, are very dangerous, by catching fire, and it is almost beyond the art of man to sweep them perfectly clean; on which account all funnels are best of a circular form, as *s, s*, in *fig. 7.*

The advantages attending a circular funnel are so obvious, as scarcely to need illustration. It will prevent all the evils and inconveniences before mentioned, if properly executed. The air will ascend with the greatest ease and freedom, the soot will not adhere to the sides, nor

will there be any vacuities for the cold air to hover about in, and it will be swept with the greatest ease. This is an object well worthy the serious attention and consideration of every gentleman concerned in building for his own accommodation.

The next article under this head is the par-
geting, or plastering the inside surface of the
funnel, which is a very essential point; for if
the inside of the funnel is not very smooth,
the smoke will less or more be retarded: and
where it is rough and ragged, the soot will
adhere and stick to these parts, and there
accumulate. The regular smoothness of the
inside of the funnel greatly promotes and
facilitates the ascent of the rarefied air and
vapour, and lets them pass with ease and
freedom to the top.

We shall not dwell on the inattention and
neglect that has been hitherto shewn to this
material and important article, nor the sloven-
ly and careless manner in which it has hereto-
fore been executed by workmen. It behoves
gentlemen to be particularly careful that this
precaution is not omitted. Workmen should
have

have their pargeting, or plastering, ready at hand, properly prepared with good materials, and lay it on always at a convenient height, that can easily be reached as they advance, and work it as smooth and even as possible. In the operation they should be very attentive to prevent any loose mortar falling down the funnel, from their trowel (which may easily be prevented by having a small piece of board underneath), as it will otherwise drop upon the bended part of the funnel, harden into lumps, contribute to choke the passage, and be attended with disagreeable consequences.

Pargeting mortar, which is used for the inside of chimney funnels in London, ought to be made with care, in the following manner and proportion: To any quantity of the best and strongest lime, sifted fine, add one fourth part of fresh horse-dung, clear from dirt and straw: let them be well beat, and incorporated together, and used fresh made.

But we would recommend the following composition, as much preferable and more durable, if properly made, viz. To two bushels of good stone lime, add one bushel of fine drift

drift gritty sand, and a like quantity of sea-coal ashes, or brick-dust : skreen them fine, beat, and incorporate them together, for the first coat ; and, when well set, put on the following for the second, or finishing coat :

Take fine white plaister (commonly called plaister of Paris) mixed with stale small beer, and work it well in a trough, or tub, to a due consistence : then lay on a fine thin coat of it upon the other, carefully worked in, and as smooth and even as possible. In a short time it will assume the hardness of stone, and a polish little inferior to marble. A funnel thus executed and finished, can never be the cause of smoke ; and if the expence is a trifle more, with a gentleman of fortune, who desires a well-finished habitation, it can be no object.

*The fixing or setting of Stoves, or Grates,
in a CHIMNEY.*

THERE is as much necessity to have the grate, or stove, proportioned to the fire-place, as there is in the proportion of the fire-place to the room. If a small stove is put into a large fire-place, and a fire made in it, it is sure to smoke: for if a grate is too narrow, or too low, as the small stove *b*, in *B*, *fig. 1*, is for the fire-place, and the fire-place too deep for it, as is represented at *b*, the profile of the stove, in *B, fig. 4*, great quantities of cold air are admitted to pass above, at each end, and behind the stove, which the fire is unable to heat; whereby the current through the chimney cannot be effected. In any, or all of these cases, the smoke, instead of being forced up the chimney, is stifled and checked; the progress of the external air from below not being maintained in the funnel, the smoke must of consequence descend into the room.

It is of the greatest advantage to have the grate to come as forward as possible toward the

the room, whereby it is in every part more regularly warmed, and the intention of making the fire is attained. Where the fire is situated far back in a chimney-place, it never warms the room thoroughly, for there is very little benefit received from it, except in the front ; great part of the heat being confined by the jambs or sides of the chimney. It always hath a gloomy and disagreeable appearance, and disfigures the whole apartment, however elegantly finished and furnished in every other respect.

All stoves and grates should be so fixed as not to admit of any air to pass either over, behind, or at the sides of the fire, without being rarefied. Therefore the rule to be observed is this : let the under edge of the mantle-piece be as represented at *a*, *b*, in *A*, and *a*, *b*, in *C*, *fig. 4*, sloping upwards on the inside ; then let the front of the grate, or stove, be fixed right perpendicular under the inner edge of the mantle, as the profile of the kitchen grate *c*, in *A*, and the profile of the Bath stove *c*, in *C*, in *fig. 4*. The dotted line shows the perpendicular. Now if the mantle was thick, as represented at *a*, in *B*, *fig. 4*, and the grate

as 'far' out as in A, or C, to be within the inner lip of the mantle, it would interrupt the smoke in its ascent, and throw it out into the room. This proves the utility of having the under edge of the mantle as thin as possible; in order to bring the grate forward into the apartment. To secure the back, and prevent any vacancy for the air going up behind, let the back of the stove or grate be built up with brick-work, as *d*, in A, and *d*, in C, *fig. 4*, allowing no more room than is there represented; and in order to throw the heat more powerfully outwards into the room, let the brick-work at the back of the fire-place be carried up sloping regular as high as the gathering of the breast and wings of the chimney; above the grate, or stove, as *e*, *e*, in ditto: as the air presses in, out of the room, into the fire-place, the flame will act with the greater force, and reflect more heat into the room.

The rule for the height and width is to have all ranges, grates, and stoves full one half the height of a proper chimney-piece, as is represented in the section of the kitchen range *b*, in A, and the Bath stove, *b*, in C, *fig. 1*; the upper

upper bar of the range is 2 ft. 4 in. high, and 6 in. on each side from the jambs, and the back of the range on a circular plan, as *w, y, z, fig. 8.*

The Bath stove *b*, in the dining-room C, is 1 ft. 10 in. high, which is little more than half of the height of the chimney-piece; the under edge of the mantle-piece and back of the chimney upon the same construction as above mentioned, and represented in C, at *d*.

Ranges and stoves thus fixed in a proper constructed chimney-place, oblige all the air that enters into the chimney out of the room to pass immediately over the fire, and to become properly heated and rarefied.—The back, the contraction of the wings and breast of the chimney, and the funnel being all properly constructed and executed, as before directed; the chimney, in regard to construction, will answer every desired purpose, and the smoke be carried off clear and free from every room in the house, to the comfort and satisfaction of the owner and possessor.

Of Smoky Apartments, arising from a wrong Position and Distribution of Doors and Windows, the Closeness and Smallness of Rooms, &c. unconnected with the Construction of the Chimneys; being the second general Cause, stated Page 19.

SMOKE is often occasioned by an injudicious position of doors and windows, with respect to the situation of the chimney. For the smoke is forced into, and carried up the funnel by a continual and successive pressure of the air entering at the fire-place, which being there rarefied, rushes upwards, and carries the vapour with it into the outmost atmosphere. But if the air is diverted from the chimney by any other cause, the smoke will, of course, be carried away with it into the room: so that if doors and windows are situated in such directions as to produce currents of air, when the wind blows in particular quarters, they will be sure to occasion smoke. Add to this, that any cause whatever which tends to determine a current of air from the under part of the fire, will as assuredly be the cause of producing smoke in the apartment.

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From hence it is very easily to be conceived how the position of doors and windows may occasion smoke, especially in situations that are exposed to violent and rapid currents of winds in particular directions.

To prevent these evils the following observations ought to be attended to, as it is a matter of more consequence than is generally imagined.

First, that all doors and windows be fitted and hung as exact and close as possible, to prevent their admitting any great quantity of air ; and that all front or outer doors be made to open inwards into a close landing-place, or lobby, that has no immediate communication with the stair-case, or any passage, but through doors occasionally opening into each. Also that room doors open back towards the fire, as that will prevent the air being drawn from the chimney.

If possible avoid having any more principal front doors than one. Let it be hung on such a principle as to pass close upon the threshold when shut, to prevent the driving winds from beat-

beating in the rain at the bottom, which will be the case if not taken care of, and where it happens is very disagreeable. All doors that have any communication with that in the front, ought to be so constructed as to shut closely of themselves, to prevent the disagreeable consequences of accidental carelessness.

But if there is more than one outer door, let there be no direct communication between them. I have seen a capital house so situated, filled with smoke all over, when the wind blew in certain directions.

Secondly, never admit of windows being placed opposite to each other on both sides of the room, or doors in opposite directions to windows ; for, in such cases, they will always occasion a current of air that will more or less disturb that tending toward the fire-place. Therefore avoid as much as possible having a free passage from one side of the house to the other, or having doors opening from one room directly into another, where windows are facing on each side of the house. For if doors and windows are ever so neatly fitted, they will admit some air, particularly if the wind

blows high in the right direction, and will cause smoke to return from the chimney.

It is necessary here to observe, that if the doors in the partition transmit as much or more air than the windows in the front, a current of air will flow from all parts of the room, and therefore will have a tendency to occasion smoke. But, on the other hand, if more air comes in at the front windows than can get out at the door or doors in the partition on the opposite side of the room, in such a case there will be no current, but the superfluous air will be forced up the chimney, and carry the smoke clear off with it : hence it follows, that a room so situated is sometimes cured of the smoke by shutting up the door, or by rectifying its defects.

Now, to state a few cases—If the windows and doors are open on both sides of a room, the strong current of air passing through will draw the vapour from the chimney, and will be a sure cause of smoke. Again, if the windows upon which the wind blows are shut or closed up, and those on the opposite side opened, nearly the same effect as above would be

be the case. But if the windows upon which the wind blows are opened, and those on the opposite side shut close up, the chamber will be entirely clear of smoke ; for the admitted air, having no other vent, must directly ascend through the chimney : and this proves the necessity of having doors and windows made and hung in the most perfect and masterly manner.

Hence the following inference is deducible, viz. that the doors and windows in a room should be so disposed as not to admit a straight, or free passage, for the air to form a current from the fire-place.

More examples might be given ; but the above varieties will enable the reader to form a sufficient idea of the manner that doors and windows ought to be distributed in a room.

Thirdly, if the plan of the house admits, have as many of the chimneys in the internal partition wall as possible ; but if there are no brick partition walls, then always endeavour to place them in that side of the house that is least exposed to the wind ; and the windows

dows in that side that the wind blows most frequently and violently on : for if the current of air is towards the fire, as there is no other vent but the funnel, the room will always be clear of smoke. Therefore never let chimneys be in external walls if it can be avoided, nor doors in partitions between rooms where windows are opposite.

Fourthly, be particularly attentive to the situation of stair-cases and landing-places. Observe to make them as close as possible on all sides, and never let a principal stair-case have a direct communication with garrets, which are generally so open and airy as to occasion a constant and powerful current of air between the lower apartments and the upper, which is sure to be attended with very disagreeable circumstances. If there is no back stair-case, then the stairs to the garret from the highest floor ought to be detached and partitioned from the principal stair-case, and have no immediate connection or communication therewith.

All back stair-cases for servants, leading from the lower offices to the principal floor and

and apartments, ought to terminate in a close landing-place, communicating with the principal stair-case, passage, and rooms belonging to the house, through doors opening into each other, and those doors to be hung so as to shut of themselves in a neat close manner.

Fifthly, the situation of passages is an essential article ; and the architect, in planning, ought carefully to avoid long passages, for wherever they are, they always occasion a violent current of air, which often affects the whole house, and produces smoke in every room.

If long passages cannot be avoided, observe never to let them terminate in a stair-case, or in a room, or where there is a fire-place, nor to have an open communication with the higher parts of the house ; and endeavour to have no openings, as doors or windows, at the ends of these passages : for if there are, there will be a brisk stream of wind flowing through them continually, which will be the cause of a long train of evils, beside that of smoke. But if openings must be at both ends, make them, if possible, on one side of the house,

because then the wind will enter in at both ends at the same time, and will, in some measure, counteract each other. The entrance into these passages ought to be at one place, the most convenient for communication with the principal parts of the house, by doors secured as before mentioned.

In capital houses, where there is a necessity of having separate passages for servants, be careful that they have no direct communication with the principal passage or landing-place of the grand stair-case. Let all those communications be through passages with doors to shut.

If there are any detached buildings, as wings for offices, and ornaments, contrive the plan, if possible, to have no internal communication with the house, by any long passage, except by a covered way, &c.

Sixthly, the next thing to be carefully avoided is small rooms, particularly for bed-chambers, for they are attended with more evil consequences than is generally imagined.

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There are no apartments in a house so liable to be troubled in this particular as small close rooms, or closets ; and none are so unhealthful and disagreeable : for if there is not a sufficient quantity of fresh air constantly admitted into the chamber to supply the fire, the air in the room is considerably exhausted, and becomes lighter than the external air at the top of the chimney ; whereby, not maintaining its progress, the current in the chimney funnel will be inverted, and fill the room with smoke.

In this case the well-known cure is by opening a door or a window, and admitting fresh air, by which the proper circulation is restored ; but this remedy is neither agreeable nor safe. For a window is no sooner opened than a stream of cold air enters, and is diffused through the whole room. So that while some parts of our bodies are scorched with a brisk fire, other parts are numbed with a piercing cold, which is productive of disagreeable effects in weak constitutions.

The worst evils attend small bed-chambers, for the little quantity of air contained in them

(if the fire at bed-time burns vigorously) is too soon warmed, and often heated to an insupportable degree; and no sooner is the fire diminished, or put out, than the warm air in the room is immediately succeeded by air as cold as the external atmosphere; so that if any part of the body is for a short space of time exposed to the cold, it is suddenly seized with some violent rheumatic pains, &c.

If the fire is continued all night, and the door and windows shut close up, as often happens where sickly people repose; in this case they breathe all night in a confined atmosphere or suffocating air, loaded with the perspiration of their own bodies, very injurious to the constitution.

All the inventions for warming rooms by inclosed air, particularly that by clumsy and mournful looking stoves, are unwholesome.— Stoves do not promote a discharge of air from rooms, which yet is every moment more and more replete with vapours dispersed from burning candles, the breath and perspiration of the company, and occasionally from other sources; whence the air inspired becomes noxious.

noxious. Fresh air cannot be duly circulated where stoves are used ; nor can health be maintained where impure air is confined. All this is sufficiently evident to persons who will take the trouble to reason a little for their own sakes ; but where caprice introduces novelties, *fashion* is a word that, by a kind of magical influence, too often silences every effort to examine into *propriety*.

Large rooms are not liable to those evils ; for, by the constant action of the fire, they are more regularly heated ; the air there hath more liberty to expand itself ; therefore, at bed-time, a more moderate and regular heat is enjoyed, and being long before the warmth abates, its temperature is never in extremes, as so often happens in small rooms, which are never favourable to the weak or sickly.

Again, if there is a small chimney, or even a fire-place, of a size proportioned to a small room, and it is duly supplied with air from the windows and doors thereto belonging ; yet when the door is opened, it will press the air within the room in an undulatory manner ; and if the door is quickly shut, it will

often so force and draw the air from the fire, as instantly to fill the room with smoke, and even bring the foot down with it.

The following experiment will confirm this observation ; *e. g.* If a small room has two doors opening into it, let one of them be unlatched, and the other opened quickly, the loose door will flap close ; and on shutting the other door again, it will spontaneously open.

It is likewise demonstratively clear, that these effects take place, less or more, in all rooms, in proportion to their size. In a large room the quantity of air displaced by the door as it shuts or opens, is so inconsiderable a part of the whole, and the chimney at such a distance from it, that the effects produced are scarce discernible ; but in small rooms it is otherwise, for there the air is so violently determined down the chimney, that the effects are very discernible. Again, if a person, in a small room, moves swiftly towards a fire-place, his change of place will push the air before him, and force it up the chimney ; and if he retires quickly from the fire, a proportionable quantity is drawn down therefrom, to fill the

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vacuum left by his body: these effects will be proportioned to the person's bulk, the celerity of his motion, and the magnitude of the room.

Small chambers are attended with many more inconveniences; but those already recited will, it is imagined, sufficiently discredit them with gentlemen who wish to build agreeable mansions.

As smoke is often occasioned in close rooms by the want of a proper supply of fresh air, we will just mention, that the best method of conveying air into them, is by small tubes, communicating with the air without; which ingenious workmen may so contrive and fix as not to be perceived, and to regulate the draught at pleasure.

The common practice is to make these tubes conduct the air immediately into the fire-place, and as low as possible: but if this is not done with judgment, it frequently adds to the disease: in rooms for the reception of company, it is uncomfortable, and even unwholesome; for if the fire is supplied with a suffi-

sufficient quantity of air within the chimney jambs, it stops the current, and keeps the air in the room in a state of stagnation, and thus prevents a free circulation of air in the room.

The most perfect and complete manner of executing this operation is, by admitting the air at the top of the room*, or in the ceiling,
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* The ingenious Dr. Franklin is of the same opinion respecting the fittest place for introducing fresh air into a room. His words are as follow:— “ In all rooms where there is a fire, the body of air warmed and rarefied before the chimney is continually changing place, and making room for other air, that is to be warmed in its turn: part of it enters and goes up the chimney, and the rest rises and takes place near the ceiling. If the room be lofty, that warm air remains above our heads as long as it continues warm, and we are little benefited by it, because it does not descend till it is cooler. Few can imagine the difference of climate between the upper and lower parts of such a room, who have not tried it by the thermometer, or by going up a ladder till their heads are near the ceiling. It is then among this warm air that the wanted quantity of outward air is best admitted, with which being mixed, its coldness is abated, and its inconvenience diminished, so as to become scarce observable. This may be easily done by drawing down about an inch the upper sash of a window; or, if not moveable, by cutting such a crevice through its frame; in both which cases it will be well to place a thin shelf of the length, to conceal the opening; and sloping upwards, to direct the entering air horizontally along and under the ceiling. In some houses,

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by a tube or pipe leading from thence downwards, either on the outside or inside of the building, as the situation most conveniently admits, and the other end to communicate with the external air. In this case, the cold air would force in at the external aperture, ascend into the room, and gradually mix with the heated air, in an imperceptible manner ; dispersing itself through the room to the fire, carrying off the foul stagnated air, passing the company and candles unfelt and unperceived, constantly supplying the room with a succession of wholesome sweet air.

A fire in a well-constructed chimney, in this case, will burn with the greatest life and cheerfulness ; and if the doors and sashes are made to shut with due exactness, the company will enjoy sweet, pure, and fresh air. On this account, nothing is more desirable than open fire-places ; they perform the part of a

the air may be admitted by such a crevice made in the wainscot, cornice, or plastering, near the ceiling and over the opening of the chimney. This, if practicable, is to be chosen ; because the entering cold air will there meet with the warmest rising air from before the fire, and be soonest tempered by the mixture.

perpetual ventilator, and contribute to the health of the sedentary and recluse.

Much judgment is required in fixing these tubes or pipes : the situation of the chimney, doors and windows must be considered with attention ; for if they are not properly fixed and executed, bad consequences will ensue. The ingenious artist will observe, that the opening of these pipes need not be large ; they should be so constructed and fixed as to be regulated or contracted to any degree, and shut close up at pleasure, which may be done by means of a small slider, like that to the end of a telescope.

We are convinced, and could demonstrate it clearly, that tubes might be constructed in large assembly or concert rooms, &c. for some of them to bring the cold fresh air successively and constantly into the room, without emitting any warm air ; and other tubes constantly to be emitting the warm or foul air out of the room, and not to admit the cold external air into it. Thus, such rooms would be kept clear from all the inconveniences attending crowded assemblies, where lamps or candles

candles are abundantly consumed, and where various other means occasionally produce unwholesome changes in the air. These tubes, if rightly constructed and executed, will answer every purpose here required better than any ventilator ever yet proposed. By the above plan the room will be kept in an equal and moderate degree of heat, and the health of the company guarded from the hazards of inspiring a stagnated, confined, and putrid air.

Close kitchens in basement stories of capital buildings, where large fires are frequently used, and which consume great quantities of air, often smoke; the best way to cure them is to convey the air immediately into the chimney, and as near the fire as possible, by pipes as above proposed. In kitchens of large mansions, where fires are constantly kept, these pipes or tubes may be so constructed and contrived as to answer several useful and valuable purposes. By such means water closets, cellars, vaults, wells, and drains, &c. may be cleared of foul, stagnated air, and kept as sweet and wholesome as any room or apartment in the house, without stink traps, or any other

other troublesome machine or invention.—The utility of which any gentleman may experimentally be convinced of at a very small expence.

A particular discussion of the above two articles would lead into a very extensive field of digression, entirely foreign from our original subject, of preventing smoke in buildings to be erected, and of curing smoke in houses already built. It is hoped that the variety introduced respecting internal particulars, will enable our readers to be fully and sufficiently masters of this subject; we shall, therefore, proceed to the third and last part, with regard to situations and external objects.

Of EXTERNAL OBSTRUCTIONS from High Buildings, Elevation of Ground, as Hills, the Nature of the Region, and a due Regard from what Points the furious Winds mostly blow.

THE choice of a place for building in the country is interesting in the highest degree, for the most elegant structure may lose great part of its value from a bad situation.

In all buildings we seek convenience and pleasure ; but neither the one nor the other can be obtained, unless we properly consider the place and situation of the structure : what conduces to health, includes also our design of avoiding smoke ; therefore we shall speak of them as inseparable.

In cities and large towns, business is more regarded than pleasure ; there we are obliged to do what we can, not what we choose, particularly if cramped for room.

What comes immediately under our consideration as to country seats, is the position

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of the house, as to the elevation of the ground, and the direction of the winds, so as not to obstruct the ascent of the smoke out of the chimney funnel. As to the other, respecting water, soil, prospects, &c. they are foreign to this object.

Air is among the first and most immediate advantages of situations ; for in search of that the nobility and gentry fly into the country, for the sake of health, as on that depends the enjoyment of every other satisfaction, particularly if they are so happy as to occupy a comfortable house free from smoke.

For many reasons a country house should stand on an eminence. Every elevation of ground has the advantage of dryness, and a more wholesome air than flat and hollow places. No damp, stagnated moisture remains on it, and the air passes freely : but extremes in every thing are faulty. A building upon a very high hill has many inconveniences : the air is there too sharp ; hence the spot is commonly barren, and the winds have too much power. Though it cannot affect a properly executed chimney at the top, yet if

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the doors and sashes are not fitted perfectly close, it may cause such a current of air in rooms and passages opposite to its direction, as to occasion the house to smoke, particularly if the front door is not well secured by a portico opening into a close lobby. As all external shelters are confined to trees, these will not grow on mountainous heights; consequently the most elevated situations are not the most desirable.

It was the custom of our forefathers to build in bottoms and hollows, to shelter and screen their houses among woods, and between hills: but this is an unhealthy, as well as disagreeable situation; for if the hills and woods are of a greater elevation than the chimney tops, the house at times must smoke, without some expedient is contrived to prevent it— For when a current of wind flows over the top of any high object, as a steep hill, a grove of trees, &c. the violence of the current at first overcomes the power of the gravity in that direction: but the current soon losing its force, the air is impelled downward by its gravity, hovering in eddies over the chimneys, where, meeting the current of vapour in its

passage, the latter is often forced back into the house, and fills it with smoke.

The case will be the same almost in every particular where low houses are contiguous to high buildings ; but if the object is not very high, the disorder may be remedied by elevating the chimney.

If a house is situated on the declivity or slope of a hill, there will be no danger of smoke when the wind blows toward that side of the hill on which the house is situated ; for the current of wind rising with the ascent of the hill, will powerfully draw the smoke upwards from the top of the chimney. But a house in this situation will be liable to smoke when the wind blows down from the hill ; for the current of wind will descend in eddies over the chimney, as before observed, and prevent the smoke from ascending with freedom out of the funnel.

It may not be improper to observe here, if the building has wings, to place them on the rising ground towards the top of the hill, as the

the best situation for the chimneys belonging to them, as well as for other reasons.

If a house is situated close under a high rock, steep hill, or lofty building, it will be liable to smoke when the wind blows towards the sides of the hill or building, as well as when it blows over from them; for the wind will flow straight over the top of the low building, and when it meets with the large opposing object, it then will be interrupted in its course, and reverberate on every side. If it can find a passage upwards, it will ascend, carrying the smoke of the low building along with it, and flow off in that direction: but if there is any opening below, either a valley, street, or lane, that will admit it, the power of gravity will bear it downwards with great impetuosity by that passage, in a gradual inflected direction, and, meeting the rarefied air and vapour flowing from the chimney, will beat it back, and thereby be liable to cause smoke.

There are many more external accidents to occasion smoke, either in a less or greater degree, in particular situations; such as sudden and violent blasts of winds, reflecting from

the sides of hills and mountains, and rushing down hollows and valleys with great rapidity and force; occasioning, in certain places, strong whirlwinds and eddies of different kinds, powers, and directions. Indeed, whatever in any measure obstructs or diverts the free and natural motion of the wind, is liable to occasion sudden gusts, which may produce puffs of smoke. Hence it follows, that every one who builds, ought to be careful that the situation be such that the tops of his chimneys be free and clear from those obstructions, or else he may lay his account to be annoyed with occasional puffs of smoke.

Tops of chimneys executed in a proper manner, as described page 53, will prevent these ill consequences in all moderate cases: but there are some situations so much exposed to sudden and violent gusts of wind, sometimes whirling round, and beating down with great force and quickness in a straight direction, and suddenly up again, that it is a very great difficulty to guard against every danger of that kind. It may happen in many cases, that two or more of the defects above mentioned may be combined together to augment the

the malady, which may tend greatly to perplex those who pretend to cure smoky chimneys. Yet among all the various schemes invented, either one or other of the two following simple ones will effectually answer the purpose of one and all of the last above-mentioned evils in bad situations.

First, make two holes, one over the other, on each side of the funnel, as high as possible, and cover the top close over ; but let one of these holes go sloping downward, and the other go sloping upwards, so that the smoke will always find way through one of them.

Secondly, place an inclined funnel mouth, moving horizontally on a centre, made of sheet iron, or block tin, on the top of the chimney, to be turned from the wind by a vane : this need not be above two feet high ; and, if properly constructed, will answer the purpose effectually.

By these principles here laid down, it is plain that an open, elevated place, in town or country, is the best situation, both for health, prospect, and convenience ; where the air is

free, and in continual motion, then the smoke would ascend without the least interruption into the outmost atmosphere.

A situation may be very good and agreeable on the slope of a moderate eminence, where the ground rises gently up from the plain, and continues behind the house a little : if there are trees for shelter from the more disagreeable strong winds, they will do no harm, provided the tops of the chimneys are clear or above them ; but in all situations, observe that the chimney tops are the highest objects.

Let this rule be strictly observed by the architect, on the first disposition of all buildings ; to consider well the nature of the region, and from what quarter the wind most frequently blows. According to this consideration, let the rooms that fires will be most used in, be situated where the wind has the least power : and, as before observed, let the chimneys be placed in the internal or partition-walls, if possible.

Also in large houses, where the apartments are numerous, that they may be distributed and suited to the seasons of the year, as well

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as for their several uses. Thus rooms for summer may be placed towards the north or east, and winter rooms towards the south and west, because we seek coolness in summer, and in winter as much sun as possible ; and that all fronts or principal doors be on that side of the house that the wind blows the least in, and the less furiously. For want of this early and timely precaution, many principal houses have always been pestered with smoke, and no art used has been able to cure them.

If the several directions and cautions here given, for the constructing and erecting of chimneys—for the true distribution and position of the several internal parts—and with regard to external situations and objects, &c. be truly observed and executed, GENTLEMEN will have little reason to apprehend any danger of smoke in their houses.

EXPLANATION OF THE PLATE,
WITH REMARKS.

FIGURE I.

IS the section of a stack of chimneys five stories high, for a first-rate house; representing the opening of the fire-places, according to the table of proportions, to the size of the rooms; shewing the proper method of gathering the wings above the mantle, and the regular direction of the funnels from the wings to the top of the shafts; with the dimension of each funnel, and the height of each story, &c. divided as follows.

A. The section of a kitchen chimney, in the basement or lower story, supposed to be 24 ft. 4 in. in length, 17 ft. 4 in. in breadth, and 10 ft. 6 in. high.

c, d, e, f, represents the fire-place, or opening of the chimney; *c, d,* the height 4 ft. 6 in.; *d, e,* the breadth 5 ft. 6 in.

b, the range in the fire-place, fixed in a proper manner.

a, b, represents the proper form and method of gathering the wings from the mantle-piece

piece to the mouth of the funnel ; and from hence the true and regular direction of the funnel to the top at *b*.

d, g, the height of the gathering of the wings 2 ft.

i, is a small flue for a copper, oven or stove, in a proper direction to the principal funnel *a, b*.

N. B. We by no means advise flues to be laid into funnels, as they often are the occasion of smoke ; therefore let them always be avoided if possible : but if they must be had, never let them go into the funnel horizontally, but always in an inclined direction, above the gathering, as represented.

B. The section of a proper chimney, on the parlour, or ground floor ; the room 18 feet square and 12 feet high.

a, b, c, d, the fire-place or opening of the chimney ; *a, b*, the height 3 ft. 6 in. ; the breadth, *b, c*, 3 ft. $5\frac{1}{4}$ in.

b, e, the height of the gathering of the wings 1 ft. 4 in. per dotted lines crofs.

e, f, the height of the perpendicular direction of the funnel 1 ft. 8 in. ditto.

g, b,

g, b, the proper direction of the funnel to the top of the chimney.

b, a common small stove standing in the fire-place, in an imperfect state, being the sure cause of smoke. *Vide* page 23.

C. The section of a dining-room chimney in the one pair of stairs, or principal floor, being 24 feet by 18 feet, and 14 feet high.

r, o, b, t, the opening of the chimney 4 ft. $0\frac{1}{2}$ in. wide, 3 ft. $1\frac{1}{2}$ in. high.

N. B. An addition is made to the height and breadth of the opening, according to the directions in the explanation of the table of proportions, the ceiling being 14 feet high.

c, l, the height of the gathering of the chimney wings 1 ft. 4 in.

e, f, the height of the perpendicular direction of the funnel 1 ft. 8 in.

g, b, the proper direction of the funnel to the top of the chimney.

b, A Bath stove properly fixed. *Vide* page 62.

D. The section of a chamber-chimney, on the two pair of stairs floor, 18 feet by 16 feet, and

and 10 feet high, with the representation of the opening of the chimney, the gathering of the wings, and the direction of the funnel, as before described.

E. The section of a chimney in the garret story, 18 feet by 12 feet, and 9 feet high.

N. B. There is a deduction in the size of this chimney, the ceiling being only 9 feet high, according to the directions given in the explanation of the table of proportions.

F. The roof, or space between the garret ceiling, floor, and the upper ridge of the roof.

G H. The shafts of the chimney above the roof, finishing in the form of a pedestal, agreeable to order; *b, b, b, b, b*, the funnels; *c, c, c, c*, the partition-walls between the funnels, with grooves. *Vide* page 53.

FIGURE II.

The section of a chimney and funnel upon an erroneous construction. *Vide* pages 25 and 45.

N. B. The above ill construction is strongly recommended by Mr. Isaac Ware, in his

Complete Body of Architecture, and by some authors of less note.

FIGURE III.

The section of two fire-places, and two funnels.—*a, b, c, d, e, f, g, h*, in A, is a bad executed and constructed funnel. *Vide* pages 27 and 46.

c, d, in B, is a wrong constructed funnel, executed in common by many of the brick-layers, particularly in garrets and small houses, and is recommended by some old authors. *Vide* page 24.

N. B. When the aperture or wings of the chimney above the mantle is too wide, and not properly contracted, as the above-mentioned funnel; *M, N*, in the funnel, represents two plates of milled iron, fixed level with the lower edge of the mantle to the wall, with neat small hinges, and so contrived as to be taken out with ease, at pleasure, to clean and sweep the chimney.

The most perfect way to put them up, is to place one of the plates a little lower than the other, and made so long that the ends should

should cross each other, as *m*, *n*, by which means every particle of air will be forced to pass immediately over the fire.

These plates will admit of being raised or lowered at pleasure, by a wire fixed to the upper edge of the plate, either to pass through a small hole made in the jamb of the chimney to the outside as at *O*, or so contrived by a pulley as to come down the inside of the chimney jamb. It may there be joined to a handle in the form of a bell handle, and, by a spring with notches to catch the handle, may be made to raise or depress the plates without blemish or inconvenience to the fire-place. By means of these plates, the whole force of the fire is necessarily brought to act upon the aperture, where they pass one another; and as no air can enter the funnel but through that contracted passage, it must be strongly heated, and will therefore rush through quickly to the top of the chimney; or this will occasion a constant and rapid draught of air in the funnel, which is the only means of carrying off the smoke with certainty.

If these plates are made to fit exactly the sides of the chimney all round (when there is no fire used), they may be let down close to touch one another, which will answer every purpose of a smoke-board, and will intercept any soot or dirt that might otherwise drop down the funnel into the fire-place ; and if smoke at any time is accidentally beat down the chimney by a sudden gust of wind, it will be in like manner stopped by the plates from descending into the room.

Plates properly constructed, and fitted with exactness and neatness, would in many respects be of service even to a well-constructed chimney : for when a fire is first kindled, a great quantity of gross vapour is exhaled, which fills the chimney, and makes room, particularly in the wings, necessary ; but after the fire begins to burn clear, there is no occasion for so much vacant space, which on many occasions is attended with inconveniences, as too large a quantity of the heated air is transmitted out of the room, and carried off up the chimney, which ought to warm it. Such plates, therefore, properly fixed, would contract or dilate the passage of the rarefied air

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at pleasure, keep the room always in a proper degree of warmth, and convey the smoke away with the greatest certainty. They may be so ordered as to make the fire burn brisk or slow, and answer every purpose of a regulating stove, without their disagreeable appearance and great expence.

When this contrivance is adopted, the back of the chimney, as *g, f, fig. 6*, and the gathering of the wings, must be constructed square, and truly executed; as then the plates may be fitted in with great exactness, and at pleasure be drawn up close to the wall, so as to leave the opening of the chimney almost as clear as if there were none.

In kitchens, where, on particular occasions, the utmost width of the chimney is required, which at other times may be as inconvenient, these plates would be found peculiarly serviceable, when only a small fire is used.

FIGURE IV.

The profile of three chimneys. A. the profile of the kitchen chimney in fig. 1.

H

a, b,

a, b, the gathering of the breast of the chimney in a proper manner from the mantle.

c, the profile of the range in the kitchen chimney, answering to *b*, in A. *figure 1. Vide page 60.*

d, the brick-work at the back of ditto.

e, the brick-work sloped off at the back of the chimney above the range.

B. The profile of the parlour chimney in *figure 1.*

a, the mantle on an improper construction.

b, the profile of a common stove standing in the fire-place, answering to *b*, in B, *fig. 1.*

C. The profile of the dining-room chimney in C. *figure 1.*

a, b, the gathering of the breast of the chimney properly.

c, the profile of the stove *b*, in the dining-room, *figure 1.*

d, e, the brick-work at the back of ditto.

FIGURE V.

The plan of the aperture of the chimney of the dining-room in C. *figure 1*, from the mantle piece *o, b*, to *n, n*, in ditto.

a, b,

a, b, c, d, represents the gathering of the wings and breast in a circular form, beginning immediately at the under edge of the mantle piece at *o, b, m*, in C. fig. 1. gathering regularly to the mouth of the circular funnel, *n, n*, in C. figure 1. *n*, is the mouth of the circular funnel, which *a, b, c, d*, is to gather to, in a circular regular manner, at 18 inches high, as is represented by the dotted lines, in C. fig. 1. *Vide* page 47.

N. B. This work will require much more time, care, and attention (if executed in perfection), than the common bungling method of building chimneys at present in practice: and as some chimneys, from their position, and the direction of their funnels, will be more difficult to execute than others, and as workmen have different methods in the execution of them, it is impossible to fix a certain value thereon; therefore the best way would be, to estimate the chimneys, separate from the other parts of the building, by the quantity and quality of the materials used, and time expended in the execution thereof.

Note. These chimneys ought to be executed by none but workmen of merit and ex-

perience: and we think it our duty to caution gentlemen, never to suffer them to be undertaken by *contract jobbers*, or to be rectified by chimney doctors; for it is contrary to the interest of these honest gentlemen, to execute work well, even if they can, and are well paid for it.

FIGURE VI.

a, b, c, d, the plan of a chimney; *d*, the fire-place or hearth, the jambs coming out from the back, square, or right angles, as *f, g*; *e, e*, two square funnels. *Vide* pages 20 and 42.

FIGURE VII.

k, l, m, n, plan of a chimney; *o, p, q, r*, the fire-place or hearth, the jambs sloping inwards, or coming out from the back in an obtuse angle, as from *p, o*, and *q, z*.—*s, s*, two proper circular funnels. *Vide* pages 44 and 55.

FIGURE VIII.

r, s, t, u, the plan of a chimney; *w, y, z*, the fire-place, the jambs and back forming the

the plan of a segment of a large circle, or rather an ellipsis. *Vide* page 43.

FIGURE IX.

Is the upper shaft of a chimney, terminating the building and finishing, in the form of a pedestal regularly according to order.

FIGURE X.

Is a chimney shaft, with pots fixed on it, which is now become the fashion in most of the new buildings.

These are exhibited to shew the contrast, and effect in point of symmetry, according to the rules of architecture: the one being an agreeable finishing, the other equally mean and frivolous. Nevertheless, some surveyors, who affect to be architects, have had confidence enough to pronounce, that pots are pretty ornaments on the tops of chimneys. But we have many architects, at present, who attempt grand and noble undertakings, and yet only leave behind them lasting monuments of their ignorance.

Some

Some indeed, who have too much modesty to go all lengths with their brethren, will say, that though pots upon chimney tops have a disagreeable appearance, yet they are in reality found necessary in preventing houses from smoking.

To this I answer—Pots are never of service, but where contraction and height in the funnel are required : and being circular, they are in such cases sometimes found useful : but I have often known them to cause smoke, and therefore to have been properly taken down ; when the chimney has done better without them.—A remarkable instance of this may be seen at a nobleman's house near the south side of Berkley-square, in a large stack of chimneys, consisting of eight funnels ; where one pot is taken away from a funnel near the middle of the shaft ; and I am well informed, the chimney hath never smoked since, though it always smoked intolerably before.

Pots are mostly of a bad construction, being contracted too narrow at top ; and their sloping outwards causes the wet to run down the inside. The foot and rain thus soon clog up the orifice of the pot, which obliges

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the chimneys where they are fixed, to be often swept: and the sweeper sometimes finds the foot so congealed, as not to be cleared away without scraping off with a knife. From this and other reasons, the boys are careless in sweeping them properly, being afraid to go up them.

The following circumstance happened at a gentleman's house in the course of last summer.—The porter complained that the chimneys were never half swept, and told the boy, if he did not go up to the top of every pot, and clean them well, he would give him nothing for his trouble: the lad, willing to do his best, in struggling and endeavouring to get up the inside of one, the pot and boy came rolling down the roof, into the middle gutter; the pot broke, but, providentially, the boy escaped being hurt.

Chimney pots are very dangerous, if not properly and carefully fixed, which is seldom done. There are few high winds happen without instances of some of them being blown down, and damage done by their fall.

Some years ago, a pot blown off a chimney fell upon the sky-light over a principal stair case, went through, and broke a valuable chandelier, damaged the hand rail, some of the steps, and greatly terrified the family.— But a more serious accident happened about three years ago, at Mr. Hatchet's in Oxford market, where a boy went up to sweep the back parlour chimney, which had a pot on it: in endeavouring to clear the congealed soot from the top, the pot, and the boy in it, fell down into the back yard upon a heap of rubbish. The pot, as may be supposed, broke to pieces; the lad was taken up for dead, and sent to the Middlesex hospital, where he remained a long time before he recovered; and a maid servant washing in the yard, was so terrified that she fell into fits, and continued ill for a considerable time. Several other accidents might be mentioned from pots being blown off chimneys, therefore they ought always to be avoided; for, if a chimney is curable, other remedies may be applied, much more complete and safe. To a well-constructed funnel they are very prejudicial.

In high winds nothing can be more irksome

some and disagreeable to a delicate and sickly person, than the horrible noise the wind makes in whistling round them, which may be heard in every room of a large house. What opinion must foreigners form of English artists, when they see the chimney tops of royal palaces, public buildings, and most of the noble edifices in this metropolis, disgraced with unsightly and dangerous machinery !

I shall just conclude with observing, that if the preceding directions are strictly followed, all the forementioned evils and inconveniences will be entirely avoided ;—and gentlemen may be assured, that if the funnels are properly executed and pargetted, they will never be disturbed with smoke, nor their families terrified with alarms of fire, which so frequently happen in bad constructed chimneys.

I must anticipate an objection that may be made, to the difficulty of sweeping the circular funnels ; as it may be urged that, by their roundness and smoothness, the boys can have no hold, and will not be able to get up them.—I allow that they will

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not be so easily swept in this manner as a square funnel : and I sincerely wish, for the honour of this nation, that the sweeping of chimneys by boys was abolished. It is shocking to humanity, and disgraceful to a free and civilized nation, to doom poor destitute orphans to that slavish and cruel employment. Infants who have unhappily lost their parents, or who are unnaturally deserted by them, become the children of the public ; and it is a savage abuse of trust, to drive them up these loathsome funnels, as soon as they acquire the use of their tender legs.

The method I would recommend for sweeping circular funnels is, to have a strong round brush, made full to the size of the funnel, and about two feet in length, with a staple at each end, for cords to be fastened to : if this is drawn up and down the chimney by a man at the top and another below, the chimney will be swept clean in the most perfect manner, as it is practised in several parts in the north of England, where I have been ; and, as I am also informed, in Scotland and Ireland. A loose bunch of furze will clean a square funnel equally well.

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The ready way to perform this operation, is to drop the lower end of the cord down the chimney, to the man below, with a piece of lead, or a stone fastened to it, and the brush to be put in at the top ; and so pulling up and down by degrees all the way, which will perfectly clean the chimney. If the man below ties his end to a mop-stick, he may play it up and down behind a chimney-cloth, without injury to his eyes. This method is preferable to sweeping by boys : for the plastering on the inside of the funnel will not be hurt by the brush ; but will be liable to be broke by the boys with their iron scrapers and brush-heads, who will also be tempted to dig holes in the plaster for their feet.

The circular funnels will seldom want sweeping ; for, being smooth and regular, the soot will not adhere to the sides, as in the corners of common square funnels : however, no chimney that is used ought to remain unswept once at least in a year. The late act of parliament respecting fires in chimneys dictates this precaution.



